comparatively thick plated copper plate and iron plate, and the both are connected, such as by press contacting and spot welding.

Although a large current flows through the sealer, since the length of the sealer is about 20-40 cm, a voltage which appears at the both ends thereof merely reaches to about 15-30V. For this reason, the commercial power source voltage of 100-220V had to be adjusted by making use of a voltage regulator such as a transformer and an electronic circuit.

Since the press contacting and the spot welding of the heater wires is manual work which requires human senses, it may cause irregular lengths of the heater wires, defective products and lack of accuracy, and that tends to cause overheating of the connected portion and shortening the lifetime of the heater wires.

Further, the electrode, which is press contacted and spot welded has a substantial thickness, the thick electrode portion could not be mounted on a heater stand, therefore, when a conventional expansion absorbing device 15 as shown in Fig. 5 is used and the heat generation portion is extended, both ends thereof float in the air and are overheated, therefore, it has frequently happened that holes are caused in the polyethylene over the over heated portions.

Further, the transformer is very heavy, and with regard to the voltage regulator in the form of the electronic circuit since the voltage thereof is comparatively low in comparison with the power source voltage and the current thereof is large, the control of the voltage regulator is difficult and fault likely occurs, and further the prices of these two components are high.

In the book binding machine and the laminator, a metallic bar and a roll having a large thermal capacity are heated by a heater which is formed by winding a nichrome wire around a mica plate and is used under a thermal equilibrium state. Even if the amount for processing is slight, there is a waiting period of 5 to 10 minutes until the metallic bar or the roll are heated.

A prior art of the present invention, JP(U)-A-57-167004 (herein below will be referred to as citation) discloses a zigzag shaped heater wire which is formed by cutting slits on a tape shaped metallic layer pasted on a glass epoxy resin substrate from both sides thereof alternatively in perpendicular direction to its longitudinal direction, and of which configuration is very similar to the present invention.

However, the objects of the citation are to prevent braking of the heater wire due to force of a thermal expansion use spring, to eliminate a transformer by narrowing a broad width heater wire and to enhance heat dissipation property. The prior art, however, is silent to eliminate the zigzag shape on a seal line by decreasing a gap of the respective slits and never refers to such an object.

With regard to the gap size, the citation indicates that the gap size is about three times larger than the thickness of the metallic layer. Since the thickness thereof in an embodiment of the citation is 0.1mm, the gap will be 0.3mm, but an iron chrome thin plate with no tempering having a thickness of 0.1mm cannot maintain its given shape. The heater wire's shape, according to the present invention, can be maintained without trouble. An experiment was performed thereon in such a manner that while covering a teflon coated glass tape of 0.1mm over the thus produced heater wire, the heater wire was heat sealed according to the embodiment of the citation, however, gaps clearly appeared on a seal line. If a metallic wire with no tempering is used, thickness of 0.2mm is required, then according to the citation the gap will amount to 0.6mm in such instance the gaps will clearly appear on the seal line.

Therefore, the disclosure in the citation, "the seal width is 5mm corresponding to the width of rectangular pulse wave as shown in Fig. 1," ~~likely~~ possibly suggests that the seal line is in a zigzag shape as it is. However, if the gaps on the seal line disappear, it is presumed that such will be caused by the heat accumulated therearound including a substrate, because the citation indicates that the scaling time is 4 seconds which is 4-8 times longer than a sealing time of 0.5-1 second of a usual sealer, on one hand it is presumed that such is because of poor heat dissipation which is contrary to the original object of the citation, regardless the citation nowhere suggests that the gaps should be limited as much as possible.

Further, in the citation, it is necessary to keep the shape of the metallic plate by adhering the same on a glass epoxy resin substrate, however, in order to reduce cost in mass production with regard to metallic portions, photo exposure and etching is performed over a broad area, therefore, the citation raises problems and includes unsolved problems as follows. How the glass epoxy resin substrate is cut? Whether the heat resisting property of the epoxy resin substrate can be maintained because the operation temperature of the sealer for such as PP rises to more than 150°C? What

sort of adhesives having durability is used? Whether the heat dissipation property due to the closely contacted substrate is deteriorated as referred to above? Whether the sealing time is prolonged because of the heat absorption by the substrate? How the both ends of the lead wire portion can be taken out to the outside in a flat state because the both ends of the lead wire portion also serve as the pressing faces?

SUMMARY OF THE INVENTION

A heater wire is formed in such a manner that a thin plate of resistance material, such as iron chromium, is further thinned by rolling, and is properly strengthened, such as by tempering, thereafter the same is processed by photo-etching then the width of electrode portion a portion which is required to suppress heat generation is broadened so far as permitted; a heat generating portion is shaped into a desired configuration with a narrow uniform width, then both portions are integrated.

Further, a measure is applied to the electrode portion which eliminates the drawback of swelling in a seal line.

The heater wire is formed in a zigzag shape of narrow uniform width over the entire desired configuration of the heat generation portion which causes gaps in the formed seal line or plane to disappear due to the heat diffusion from the heater wire.

Still further, by making use of the heater wire, an impulse-type book binding machine and laminator may be produced in which heating is performed instantaneously to melt an adhesive on an inside resin and then interrupts the current supply to cool the same.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Figs. 1 through 3 are plane views of embodiments of heater wires of the present invention and embodiments of seal lines in the formed melting and adhering traces through sealing.

Fig. 4 is a side view showing an expansion absorbing structure of a heater wire caused by itself.

Fig. 5 is a side view of a conventional expansion absorbing structure.

Figs. 6 and 7 are plane views showing application embodiments of the heater wire of the present invention.

Fig. 8 is a plane view showing an embodiment of heater wires of the present invention for a bag with a cat pattern.

Fig. 9 is a plane view showing a zigzag shaped heater wire and the seal line formed thereby.

Figs. 10 through 12 are enlarged plane views of heat generating portions thereof.

Fig. 13 is a plane view showing another heater wire.

Fig. 14 is a plane view showing a connecting portion with a heater wire.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 is a plane view of a heater wire 1 and its seal line 2 in an example of the present invention. The heater wire 1 includes a heat generating portion 3 having a width of 2mm and electrode portions 4 having widths of 5mm which are formed from a same plate member by photo etching in such a manner that on a thin plate which is formed by rolling an iron chromium material into 0.lmm and is adjusted into a proper hardness a photosensitive material is coated in advance, after photo-masking a pattern the coated photosensitive material is exposed and fixed, thereafter, further covering a necessary portion with a film and dissolving and removing unnecessary portions by acid to complete the same. In the electrode portions of the present invention even if a same resistance material is used, when the width of the electrode portions is broadened more than about two times, it can be controlled and no sealing is effected at the portions.

When the heater is used for household use in which the number it is used is small, no problems occur, however, when the heater is used continuously, the heat in the heat generating portion gradually spreads into the electrode portions 4, swellings 5 are formed in the seal line 2 of the heater wire 1 due to the width expansion of the electrode portions 4 at both ends thereof. If a force applied to a bag is concentrated onto the swelling 5, the seal is likely broken. There are three countermeasures therefor.

The first countermeasure is to place heat absorbing electrode plates 6 at the positions of the electrode portions 4 so as to overlap therewith, as shown in Fig. 2,

thereby, the heating is stopped at their overlapping portions as shown by the seal line 7, the heat absorbing electrode plate 6 which is disclosed in Japanese Patent Application No. Heiseil 8-346654 is a thin plate of alloy materials having good electrical and, in particular, thermal conductive property such as nickel plated phosphate bronze. Drawbacks of this measure are the increase in the number of parts correspondingly and, because of current flow between the heat generating portions 3 and the heat absorbing electrode plates 6, to consume the heater wire comparatively rapidly at their contacting portions.

A second countermeasure is, in order to prevent swelling of the seal line at the side of the bag main body, either to offset the heat generating portion 3 from the center, to eliminate the width broadened portion 8 at the side of the bag main body and to double the width at the opposite side or as shown in Fig. 3 to retreat the width broadened portions near both ends, as illustrated, in comparison with the width broadened portion 9 at the opposite side, which forms the side of the bag edges. In this instance, although the swelling 11 on the seal line is formed, it only appears at the side of the bag edges. The above indication at the sides of the bag main body and at the bag edges is, of course, only one of the standards which implies that the swellings are aligned at one side where the adversary influence is small.

The same effect can be obtained if the heater wire 1 is bent perpendicularly along the broken lines 12 as in Fig. 3. This is for preventing unnecessary elongation of the sealer. When the electrode portion 4 is bent perpendicularly as illustrated by the side view in Fig. 4, a pillow shaped projection 14 is placed before the fixing screw 13 to apply a tension thereto, the elongation of the heat generating portion caused during the heating is sufficiently absorbed by the electrode portion through the spring property of itself, thereby; the conventional complex elongation absorbing device 15 having many parts is unnecessitated.

The heat generating portion 3 can be formed in any shape other than a straight line. An elliptical heater wire 16 as shown in Fig. 6 is for a molding handle of a polyethylene shopping bag and a rectangular heater wire 17 as shown in Fig. 7 is for sealing an outer frame of a bag shaped filter. Further, the heater wire 17 is required to form a closed space by the rectangular seal line, therefore, if the gap at a nearby portion 18 is set below 0.2mm, the gap on the seal line will disappear.

Such relationship between gap and seal line occurs in any heater wire. Fig. 8 shows heaters for a shopping bag with an inflatable cat head which is used through experience for a balloon manufacturing method disclosed in U.S. Patent No. 5,545,117, wherein a heater wire 20 of nichrome round wire is for sealing and burning off the outer configuration, a heater wire 21 is for sealing in order to separate the cat head from the inside of the shopping bag and copper wires are connected along dotted portions 22 at both ends thereof so as to prevent heat generation. The heater is formed in such a manner that after arranging these round wires into a desired configuration, these are fixed by fluoro resin coated glass cloth with adhesive to fix the same. The cat face and the handle are illustrated to facilitate understanding of the above explanation.

At this instance, at the portions where the two heater wires come most close, in the two portions at the root portion of ear and jaw portion, it is necessary to keep air tight, therefore, the heater wire 21 is closely contacted at the portions by adhering a glass tape having thickness of about 0.1mm but electrically insulating one portion from the other. Because of adhering the tape at the portions, the sealing temperature tends to be lower, however, since the heater wires are closely located, much tendency is cancelled out, further, through controlling the supply current, the above arrangement is operated sufficiently and it was found out that no air leakage gap was formed in the resultant seal line.

A heater wire which makes use of the above arrangement is one shown in Fig. 9, in which the width of the resistance material is narrowed and fine slits are cut in a heat generating portion 23 to form a uniform zigzag in perpendicular direction in the longitudinal direction thereof, and Figs. 10 through 12 are partially enlarged views thereof. When these heater wires are used and if the slits are sufficiently small, a beautiful single seal line 24 as illustrated can be obtained. Further, the zigzag is interrupted immediately before the electrode portions at the both ends and is restored to the original width. No problematic end swellings appear on the seal line 24, which is the third countermeasure.

The resistance value of the zigzag shaped heater wire is about 25Ω wherein fine slits of about 0.2mm are cut on the heat generating portion 23 with an interval of about 0.4mm in a zigzag manner, on the other hand, an electrical resistance of a heater

wire having the width of 2mm and length of 200mm which forms the same seal line as above is 2Ω. Therefore, in the electrical point of view, the latter conventional heater wire requires about 16V and 8A, on the other hand the heater wire of the present invention forming the same seal line as the conventional one requires a high voltage of 50V and a low current of 2A.

If the commercial source voltage is 100V, it can be applied only by subjecting the same to halfwave rectification, further if the length of the heater wire is prolonged to 1.4 times to 280mm, the commercial source voltage of 100V can be directly applied to the heater wire. Still further, if the commercial source voltage is 200V, when the length of the heater wire is prolonged to two times, the commercial source voltage is applicable to the heater wire after subjecting the same to halfwave rectification, however, when the width of the heater wire is modified to 3mm and the length thereof is prolonged in total to three times, the commercial source voltage of 200V can be applied as it is, thereby a transformer and a voltage regulating circuit can be completely omitted.

Since the zigzag shaped heater wire of the present invention is fixed while minimally expanded, the expansion and contraction due to heat can be absorbed by the heater wire itself, the conventional complex expansion absorbing device as shown in Fig. 5 is unnecessitated as well as the simple device as shown in Fig. 4.

The reason how the gaps disappear from the seal line when the heater wire includes the gaps is that the heat generated is transferred toward the gaps via the covering fluoro resin coated glass tape and the polyethylene film itself to be sealed. Therefore, if the usual thickness of 0.1 - 0.2mm is further thickened or the generated thermal amount and the generating time are increased, the gaps on the seal line will disappear even if the gap is more than 0.2mm. Further, the gap of less than 0.1mm is, of course, preferable, however, the mass production using etching will become difficult. Within the defined range, a gap having a taper as shown in Fig. 11 is acceptable.

Further, it is permitted to modify the width of the heater wire, since the heat generation amount is anti-proportional to the width, through combinations with the gaps, heaters having a variety of effects can be manufactured. For example, as shown in Fig. 12, although the heater has the same or the substantially the same configuration

with regard to sealing, the temperature distribution thereof is varied in such a manner that at the center portion in the width of the heat generating portion is set high and the surrounding portion thereof is set lower, thereby possible edge cutting can be prevented. In fact, since heat generating density is also anti-proportional to the interval of the gaps, the same effect as increasing the taper of the gaps in the heater wire as shown in Fig. 11 can be obtained.

With an annealed material such as iron chromium material and nichrome alloy, a heater wire having width of even 2mm is soft and deforms during treatment thereof, if the thickness thereof is not about 0.2mm. However, these days a thin plate having thickness of 0.lmm can be manufactured by an economical rolling and when the thin plate is strengthened through a proper degree of quenching, a heat generating portion having a zigzag in the interval of 0.4mm as referred to above shows a sufficiently practical strength. However, if the tempering is too strong, the zigzaged heat generating portion is likely to break, therefore, the quenching amount has to be proper.

Since the operating temperature of the heater wire is below 200°C and is far below the quenching temperature of more than 600°C, no tempering occurs due to the heating. Further, other than the tempering a strengthening processing such as reforming by means of such as rolling and forging can be applied. To sum up, with regard to thickness of the heater wire, the thinner, the better so long as the strength thereof can be supplemented such as by tempering. The zigzag direction in the longitudinal direction as shown in the plan view in Fig. 13 can be used, however, since each zigzag length is longer, a further higher mechanical strength is required. Accordingly the strength thereof depends on the properness of its configuration design. Further, in the case of the heater having a broad area as shown in Fig. 13, any manner of covering the area with the wires and gaps are permitted and the zigzag shapes as defined in the claims cover all of these zigzag shapes. Further, other than the zigzag shape defined only by straight lines, zigzag shapes defined by curved lines are also included and, other than the heat generating wire itself of straight line any shapes of heat generating wires, such as a curved one and one having different widths can be used.

Further, as processing methods thereof, wire cutting and laser cutting can be used. Although a heater wire is not an expensive article, a transformer can be omitted

by modifying the processing of the heater wire, the heater wire can be manufactured in view of the saved cost of omitting the transformer. Accordingly, although the etching is a very economical method, the present invention is not limited thereto. Other than the zigzag shaped heat generating portion 23 formed integral with the electrode portion 4, as shown in the plan view in Fig. 14 the present invention includes an arrangement in which the zigzag portion is connected via a width broadened connecting portion 25 to the electrode portion 4 through spot welding.

Further, the sealer pressing mechanism of the present invention includes a pressing operation via a worker wherein the worker grips a T shaped hand type handle being provided with a heater at one side thereof by the hand and performs heat sealing by pressing the same on polyethylene placed on a work stand. Further, since the present heater can be operated while omitting the voltage regulator, the power source circuit implies a simple current supply from the power source to the heater. Further, since the impulse sealer of the present invention is lightweight and can be directly coupled to a power source, the present impulse sealer can be actively used in a field where only heating plate type heaters are conventionally used.

The above can also be applied to a book binding machine and a laminator using such heating plate type heater and the impulse heat sealer of the present type can be applied therefor. Namely, a fluoro resin tape is covered on a zigzag shaped heater wire which is shaped into a necessary configuration, with a press mechanism incorporating the same such as a bundle of paper for book binding and laminated films are pressed, a comparatively large current is fed thereto for a short time to heat the same and is interrupted to cool the same, thereby an adhesive of such as heat meltable resin is melted and adhered. For example, since the zigzag shaped heater wire can be shaped in a rectangular shape, such heater wire is suitable for laminating a photo for an identification card. Such heater can be used any time when desired, moreover, such heater is not required to be always heated which contributes to energy saving. The heating equipment such as the impulse heat sealer as defined in the claims includes the above referred to a book binding machine and laminator.

Industrial Applicability of the Invention

According to the present invention, since the heater wires can be formed by making use of photoetching, heater wires of any configurations can be manufactured

accurately in large amount and with low cost, in addition, causes of shortening life time of the heater wire such as overheating due to poor spot welding is eliminated.

Since the electrode portions are formed thin as the heat generating portion, the electrode portions can be extended over on the heater stand, the undesirable formation of penetration holes on a processing subject due to overheating because of the floating in air of a part of the heat generating portion which likely happens at both ends of the conventional extension absorbing device is prevented.

Further, since the zigzag shape of the heater wire is formed with narrow slits which cause to disappear the slit gaps on the seal line, the voltage to be applied to the heat generating portion can be approximated to the voltage of the power source, thereby, a voltage regulator such as a transformer is unnecessitated and the structure thereof is simplified. Because the heavy transformer is omitted, the weight of the present device becomes very light and the cost thereof is lowered.

Further, since a possible distortion due to thermal expansion can be absorbed by the spring property of the heater wire itself and the zigzag shaped heat generating portion further enhances the distortion absorbing effect, thereby, the extension absorbing devices which usually have to be provided at the both ends of the heater wire can be simplified or unnecessitated.

Thus, the impulse heat sealer itself can be easily manufactured and the cost thereof can be lowered extremely.

Further, by making use of the heater wire of the present invention, an impulse heat sealer type book binding machine and laminator can be manufactured, and the present heater wire can be used instantly which contributes to energy saving.

Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.